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## A BIOLOGICAL EXAMINATION OF LAKE GEORGE, N. Y.

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**D**URING the summer of 1920, the New York State Conservation Commission maintained a field laboratory on Juanita Island in Lake George. The writer was placed in charge. Dr. Chancey Juday of the University of Wisconsin, was at the laboratory in August studying temperatures, plankton, and dissolved gases of the lake at different depths. Dr. Emmeline Moore, of the Commission, was detailed to assist in the work of studying the food of fishes and of tracing it back to its sources in the lake vegetation of the shores and of the plankton. State Fish Culturist, Mr. John W. Titcomb, of the Commission, was also present during August studying fishes. Messrs. Charles K. Sibley, of Kingston, N. Y., and William R. Needham, of Ithaca, were regular assistants at the laboratory during the whole of the season. Visiting naturalists who participated to some extent in the work of the laboratory at times during the summer were Mr. S. C. Bishop, New York State Zoologist, of Albany; Professor C. R. Crosby and Dr. M. D. Leonard, entomologists of Cornell University; Miss Sue J. Reid, secretary of the Chicago Nature Study Society, and Miss Jay R. Traver Supervisor of Nature Study at Wilmington, Delaware. The object of this laboratory was to determine conditions in the lake affecting the life of food and game fishes. A report has been made to the commission on fish cultural matters. And at its completion it has seemed to the writer that a number of observations made in the course of this work that are of a more general scientific sort might be helpful to other field naturalists and ought to be placed on record: hence, this paper.

The water of Lake George is "soft"; and the dominant plants and lesser animals are quite different from those of the lakes in Central New York. Doubtless the most abundant plant in the lake—the one that bulks largest—is the stonewort *Nitella opaca*. It occurs at depths between 18 and 45 feet and covers scores if not hundreds of acres of the lake bed between these depths. It forms great meadow-like beds of erect or recumbent, soft, translucent bright green stems often three or four feet long. These beds (called "grass" by the local fishermen) furnish shelter and support for a large population of sessile algae; for case-inhabiting insects, such as caddis worms and midge

larvae; for free-living animals such as mayflies, snails and scuds, and for sessile hydraz and rotifers. About these beds most still fishing is done by the initiated.

Other stoneworts observed by us were all found in quite shoal water—less than 10 feet—and the most interesting of them was the extremely delicate and remarkably pretty *Nitella batrachosperma* that occurred at 5 feet, on beds of yellow ripple-marked sand, and swayed in passing waves with all the aspect of a bright green frog-spittle. This occurred sparingly but was found by us in places as wide apart as the head of Northwest Bay, the south shore of Juanita Island and the outlet channel below Baldwin. Two species of *Chara* also were found in the shoals.

In the lake bed below the level of the *Nitella* zone there grow two peculiar and characteristic green algae. One is a "Siphon alga" *Dichotomosiphon* that at 40 to 50 feet in depth is so abundant as to be a nuisance to the lake trout fishermen: the lead bob of their trolling apparatus gathers the tangled and matted threads of this plant about it and brings them to the surface in slimy dripping handfuls. This is what the fishermen know as "moss." Dr. Moore is publishing elsewhere an account of this species. The other alga, a species of *Cladophora* invades the depths where hardly any light penetrates. Its minute branching sprays usually about a fourth of an inch long and of very bright green color may be found sparingly, lying amid the bottom sediment at almost any depth in the lake below the shoals.

The most abundant filamentous alga of the shore is a species of *Tolypothrix* which fairly covers submerged stones and timbers with its little tufts of brownish-green swaying threads, always and everywhere interspersed with masses of gelatinous palmelloid forms. Among the coarser waterweeds hornwort and elodea are quite scarce and the fine tall-growing *Potamogeton praelongus* is conspicuous, forming some of the most beautiful weed beds of the lake. These weed beds occur mainly at depths of 10 to 15 feet. They shelter forms similar to those of the *Nitella* beds and many additional, including two interesting waterfleas, *Acantholeberis curvirostris* and *Eurycercus lamellatus*. The latter is abundant enough and large enough to form an important item in the diet of some of the adult game fishes of the lake.

In the plankton of the lake, diatoms of four genera were probably the most important food gatherers. *Asterionella*, *Cylotella*, *Tabellaria* and *Fragillaria*. Other algae less constant but occasionally abundant were *Anabaena*, *Aphanizomenon*, *Aphanocapsa*, *Botryococcus*, and *Staurostrum*. Among the cladocerans, which all season through were far more abundant than copepods, *Bosmina* was rather common throughout the season, *Polyphemus* became abundant for a time in

July, *Holopedium* attained an extraordinary dominance the latter part of July and two species of *Daphnia* replaced it in late August. On July 14th a net of No. 6 silk drawn for a few minutes in the lake gathered a solid pailful of *Holopedium* in a nearly pure culture. A few *Leptodoras* and a few *Daphnias* were present besides.

We found some good collecting grounds for aquatic plants and animals; and it may benefit some future naturalist who is visiting Lake George for the first time if I mention a few of them. First of all, Juanita Island itself, our headquarters, has most interesting shores. On the west the rocks rise vertically out of the water; on the north they run down in a gently sloping serried low ridges of solid rock, smooth and bare as far as the breaker line; on the northeast is a broad smooth sandy beach in a sheltered bay (here was our bathing beach); on the south is a shore line of broken rocks and at the east this merges into a narrow beach of ripple-marked sand. Eastward of the Island is a deep current-swept channel, and northward is a more sheltered cross channel in which the "grass" and "moss" of the fishermen are found. There are scattering growths of *Potamogeton*, *Ceratophyllum* and *Heterantheria* below the breaker line (which occurs here at about 5 feet below the surface) and just above it grow *Valisneria*, *Eriocaluon*, and *Lobelia*.

There is a very interesting admixture of small plants growing in the rippled sand about the dock and at the edges of the beach within the bay. The most abundant plant present is one of the least conspicuous, *Myriophyllum tenellum*, a true sand-binder of the shore, whose tufted, slender interlaced stems lie buried in the sand, and whose many leafless red branches rise erect but an inch or so above the surface, and, draped with tufts of filamentous algae, are most inconspicuous. More in evidence is the little creeping *Elatine americana*, that formed close-growing patches the size of a silver dollar on the surface of the sand, and that is fairly covered in August with minute blossoms. Intermixed with it, and likewise persistently blossoming is the curious little cruciferous quillwort, *Subularia aquatilis*, which grows erect to a height of perhaps an inch above the surface of the sand. Another pygmy component of this inch-high vegetation is the slender creeping spearwort, *Ranunculus flammula filiformis* which here spreads by stolons about an inch long in single lines of progression over the sand. Another is an undetermined closely tufted spike-rush, whose roots bear numerous slender little brownish tubers.

There are also scattering plants of taller stature here; bushy little sprays of *Nais flexilis*, pinnate sprays of *Potamogeton perfoliatus* and *P. heterophyllus*, the latter having when grown two or three oblong leaves that reach the surface. There are small tufts of eelgrass, *Valisneria spiralis*, in the more exposed places on tufts of two species

of quillwort, *Isoetes* and *I. tuckermanni macrocarpa* in the edges: there are also similar tufts of *Sagittaria graminea* with only the stubby basal leaves developed. But where there is sufficient shelter to avoid burial of its tuft-forming leaves by the sand, the pipe wort, *Eriocaulon articulatum*, comes in and forms a complete ground cover. About the edges of the mats of pipe wort are always a few water lobelias, *Lobelia dortmanni*, and the slender white stems of the former and the purple stems of the latter shoot upward together to the surface at flowering time in August.

At the west and about the charming little Boquet Island large fresh-water mussels abound wherever there is enough soil accumulated among the rocks to give them footing; and a little farther away to the southward the clay bottom about the Ranger Pool is fairly covered with a little translucent white clam, *Sphaerium tenue*, having siphons of a charming rose-pink color.

Shelving Rock Bay on the eastern shore of the lake a mile south of Pearl Point is a very fine collecting ground, having in close proximity a large variety of aquatic situations. A charming mountain brook, spring fed and full of trout, enters the head of the bay. A storm-wave reef across the head encloses a marsh of a few acres mostly overgrown with sweet-bay, but having small areas of open water, where pike and bullheads spawn. So great is the abundance and variety of marsh life found here that I can hardly specify particulars. I will only mention the abundance of desmids among the algae, and of the clusters of the bryozoan, *Lophophus crystallinus*, about the bases of emergent sweet-bay stems.

The bay itself has a broad quietly-sloping wave-swept sandy beach, one of the finest on the lake for a bathing beach. Further out toward Iroquois Island, in 35 feet of water are fine beds of *Nitella opaca* and just beyond that Island the bottom drops away to nearly 200 feet. Northward behind Log Bay Island is a sheltered harbor, and on the way into it are some fine mussel beds and then broad shoals densely covered with pipewort.

At the head of Northwest Bay on the west side of the lake, where another mountain stream enters through marshy lowlands there is another rich collecting ground. Here young fishes and minnows are exceedingly abundant, and everything that is needed to feed them is here also. Submerged logs in the stream are plastered over with colonies of the bryozoan, *Pectinatella magnifica*.

At the foot of Black Mountain on the eastern shore is *Chives Rock*, so called from a species of chives (*Allium*) that is said to grow in the narrow crevices that traverse its broad face. It presents a broad flat surface to the waves and rises directly out of rather deep water. We found this an especially good place to get a line on the lotic insects of

the lake. Many of these, which are not easily collected from the lake, climb up the flat surface of this rock to transform and leave their cast skins clinging there, most of them within reach from a boat anchored at the foot of the vertical cliff. In an hour's collecting I gathered a great number and variety of those belonging to two species of stoneflies, several species of Heptagenine mayflies, three species of dragonflies, and I noted scores of adult orl-flies, *Sialis infumata*, entangled in the spiders' webs that clung to the face of the rock. The most unexpected find here was four skins of the fine Corduline dragonfly, *Neurocordulia obsoleta*.

Doubtless there are other good collecting grounds on the lake: these are the ones we know about. A single season was not time enough for a very wide acquaintance. The clustered bays about the southeast corner of the lake, where occur the most extensive beds of shore vegetation, and where we did several days' collecting, are doubtless rich fields also.

It seems a bit strange that a body of water that is so easily accessible and that is visited annually by so many thousands of people, should be so little known biologically. Apparently not even a list of its fishes is anywhere available. Yet the islands are mostly state-owned and are offered freely for camping sites. Three passenger boats each way daily with frequent stops make any part of the lake easy of access. A grocer's boat making a circuit of the camps several times a week helps to solve the forage problem; and it would seem that these things should bring more naturalists to this, one of the most beautiful and one of the cleanest of American Lakes.